

Overview of Appendix 1

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- ✧ Remediation Work Plan
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A1.0 Introduction

This appendix provides general report outline formats to follow when submitting information to the Office of Land Quality (OLQ) under the Voluntary Remediation Program (VRP), Leaking Underground Storage Tank (LUST) Program, and State Cleanup Program (SCP). The purpose of the outline formats is to standardize and make information submitted to IDEM consistent. Program-specific chapters in the User's Guide discuss specific report additions and exclusions.

For the Brownfields Program, the investigation report outline in [Appendix 1.1](#) should be used as a template for conducting Brownfield Environmental Assessments. All site assessment procedures in RISC are recommended but are not necessarily required for brownfield sites.

All sampling and analysis procedures should be performed in accordance with the data quality objectives (DQO) discussed in Appendix 6 of the RISC Technical Guide. Routine reports and documents must comply with all documentation requirements specified in the RISC Technical Guide except with respect to raw data. Applicable quality assurance/quality control (QA/QC) documentation should be retained for all analytical work performed throughout the project, including raw data, chromatograms, recorder outputs, mass spectra, computer printouts, charts, graphs, bench sheets, and any other hard copies generated during sampling and analysis. This documentation must be available upon request.

Upon project completion, final confirmation sampling data must include all QA/QC documentation, including raw data. It is critical that sampling, sample screening, sample analytical methods, and analytical validation be performed in accordance with acceptable methods, such as SW-846, the Contract Laboratory Program (CLP) Statements of Work (SOW), and U.S. Environmental Protection Agency (U.S. EPA) national functional guidelines for the CLP. The data must be appropriate for the type of determination being made to evaluate the site. Chemicals of concern, media, and matrices should be taken into account before appropriate analytical methods are chosen to meet the DQOs. This information is also required for site characterization, health risk assessment, site remediation, legal requirements, RCRA and various remediation closures, and other relevant environmental investigations. If the required information is not available, resampling and re-analysis may be required.

Digital data submissions are requested for all sampling and monitoring information. Guidelines for digital data submission will be posted on the IDEM web page at

<http://www.in.gov/idem/land/datasubmittal/digdatasubmittal.html>

Investigation Report Overview

- ✧ Introduction
- ✧ Site Background and Baseline Project Assessment
- ✧ Statement of Work
- ✧ Project Investigation
- ✧ Investigation Results
- ✧ Conclusions and Recommendations
- ✧ Referenced
- ✧ Appendices

A1.1 Investigation Report

This report outline format can be used for preparing both investigation reports and investigation work plans. Investigation work plans are applicable to projects where OLQ remediation program oversight is either required or desired. An investigation must be conducted for all areas of concern (suspected or confirmed areas of soil or ground water contamination), as required by each program. The investigation work plan is generally prepared **prior** to any field activities and describes the investigation to be undertaken.

The goal of the investigation report is to fully define the vertical and horizontal nature and extent of contamination based on land use-specific closure values. The vertical and horizontal extent of ground water contamination must be evaluated based on residential default closure levels or estimated quantitation limits (EQLs). If RISC default surface soil, subsurface soil, and ground water investigative procedures are followed, contaminant source size determinations and minimum definitive sample numbers must comply with the requirements in [Chapter 4](#) of the RISC Technical Guide. Chapters of the User's Guide discuss in more detail program-specific reporting deadlines and further guidance. Reporting requirements may differ slightly among programs. The information requested below is essential to understanding existing site conditions and developing an acceptable remediation plan.

All information requested or required by the State must be submitted by the reporting deadlines specified by each program. Although different programs may call reports by different names or have slightly different reporting requirements, the basic information outlined below for the investigation report is the same for all programs. Specific requirements for applicable program areas must also be followed. The investigation report should be submitted in the format presented below and in conformance with program-specific requirements.

I. Introduction

A. Project Identification

1. Site name, facility identification number(s), mailing address, and telephone number

2. Site location clearly marked on appropriate U.S. Geological Survey 1:24,000 scale topographic quadrangle map
3. Current owner and operator, mailing address, and telephone number
4. Site contact person or group responsible for the investigation
- B. Overview of Current Contamination Conditions
 1. Date the spill, release, or other contamination occurred or was discovered
 2. How the spill, release, or other contamination was discovered
 3. Remediation or product recovery measures already taken, including the following:
 - a. Volume of product recovered
 - b. Name of product recovered
 4. Suspected source(s) of the spill, release, or other contamination
 5. Estimated volume(s) of the spill, release, or other contamination
 6. Approximate area impacted
 7. Date the incident was reported to IDEM and resulting incident number (if assigned)
 8. Existing deed restrictions, land-use restrictions, or environmental notice limitations

II. Site Background and Baseline Project Assessment

- A. Site History
 1. Type of facility, including description of past and current operations
 2. Hazardous materials used or stored on site
 3. Site ownership and operational history
 4. Site spill, release, and contamination history
 5. Previously completed investigations, including the following:
 - a. Reasons for previously completed investigations
 - b. Current status of site conditions that prompted or initiated previously completed investigations
 6. Potential chemical(s) of concern
- B. Geographic Information
 1. Political geographic data

- a. County name(s)
 - b. Political township name(s)
 - c. Section (1/4,1/4,1/4), township, and range locations
 - d. Universal Transverse Mercator (UTM) coordinates
 - 2. Physical geographic data
 - a. Topography and surface water flow and drainage patterns
 - b. Nearby surface waters (including wetlands and surface drainageways)
 - c. Nearby floodways and flood plains
- C. Geologic Information
- 1. Surficial and unconsolidated geology
 - a. Surface soil descriptions from U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS)
 - b. Type(s) of unconsolidated material
 - c. Thickness of unconsolidated material
 - 2. Bedrock geology
 - a. Depth to bedrock
 - b. Type of bedrock
 - c. Description of primary and secondary structural features, such as fractures, jointings, and solution cavities, that could impact contaminant migration and remediation efforts
 - d. Current status or future potential of aquifer underlying site as primary source aquifer
 - 3. Hydrogeology
 - a. Identification of regional aquifer(s)
 - b. Identification, location, and copies of the Indiana Department of Natural Resources-Division Of Water (IDNR-DOW) well records for all municipal water supply wells and other high- capacity (greater than 70-gallon per minute [gpm] yield) wells within a 2-mile radius of the site
 - c. Identification, location, and copies of IDNR-DOW records for low-volume (less than 70-gpm yield) wells within a 1-mile radius of the site
 - d. Regional depth to ground water and seasonal fluctuations
 - e. Regional ground water flow direction(s) and gradient(s)

- f. Summary of existing site-specific data
 - g. Other information, as necessary or appropriate
- D. Ecologic Information
 - 1. Potentially affected species of flora and fauna
 - 2. Potentially affected species of flora and fauna on the Endangered Species List as published by the U.S. Fish and Wildlife Service and IDNR
 - 3. Potential or observed effects of contamination on vegetation or wildlife populations
- E. Preliminary Evaluation of Potentially Susceptible Areas
 - 1. Drinking water source and wellhead protection areas
 - 2. Geologically susceptible areas, such as surface water bodies, karst bedrock areas, and other areas
 - 3. Socially susceptible areas, such as schools, parks, and hospitals
 - 4. Ecologically susceptible areas that include habitats of concern, such as wetlands, caves, and parklands
- F. Preliminary Evaluation of Possible Chemicals of Concern
 - 1. Listed or actual chemical(s) of concern, including those with a Hazards Category, those listed on Material Safety Data Sheets (MSDS), and others
 - 2. Suspected chemical(s) of concern based on site operational history
 - 3. Description of hazards categories present
 - 4. Copies of all MSDSs
- G. Preliminary Evaluation of Potential Contaminant Transport Mechanisms
 - 1. Discussion of surface water runoff (nonpoint mechanism)
 - 2. Transport mechanisms to surface water, such as drainage ditches, storm sewers, and underground utility trenches
 - 3. Discussion of ground water flow
 - 4. Transport mechanisms to ground water, such as well bores, sewers, underground utility trenches, and karst features

5. Other transport mechanisms, such as windblown particulates and physical tracking of soil by people, animals, or machinery

H. Preliminary Evaluation of Potential Human Exposure Pathways

1. Inhalation exposure pathway
2. Ingestion exposure pathway
3. Dermal absorption exposure pathway

I. Preliminary Evaluation of Potential Ecological Exposure Pathways

1. Potential impacts to aquatic life
2. Potential impacts to wildlife and vegetation

J. Identification of Existing Data Gaps that Must Be Addressed in the Site Investigation(s)

1. Site-specific geologic information
2. Site-specific hydrogeologic information
3. Site-specific ecologic information

K. Supporting Documentation

Full bibliographic information must be provided in the references for all documents used, referenced, and cited.

1. Previous applicable reports prepared for the site or the project
2. Available data and other applicable documentation regarding either the site or the project
3. Conceptual site model(s)

L. Maps and Figures

All maps, figures, drawings, cross-sections, aerial photographs, and other such information must be submitted in Appendix B of the investigation report or work plan. The maps, drawings, and other items must include suitable scales, compass directions, and clearly illustrated legends. Figures must also be provided for sites where the current conditions do not accurately reflect conditions that existed at the time of the spill or release because of building renovations, underground storage tank (UST) system upgrades, and other changes. All maps and information on the maps must be legible and

reproducible. Maps and figures should provide the information listed below.

1. Site location clearly on indicated U.S. Geological Survey 7.5-minute topographic quadrangle map(s)
2. Current as well as past locations of physical features of the site, including the following:
 - a. Property lines
 - b. Building outlines
 - c. Sidewalks
 - d. Buildings with basements
 - e. Underground and overhead utility lines
 - f. Raw materials and bulk storage areas
 - g. Aboveground storage tanks
 - h. USTs
 - i. Tank piping trenches and associated dispenser islands
 - j. Roads
 - k. Pump island piping
 - l. Property access points
 - m. Gates and fences
 - n. Loading and unloading areas
 - o. On-site waste storage, treatment, and disposal areas
 - p. Surface water bodies
 - q. On-site ground water supply wells
3. Named facilities, property lines, property uses, current land-use status (such as agricultural, industrial, or commercial), ground water wells, surface water, and other environmentally sensitive areas within a 1-mile radius of the site
4. Locations and identification numbers for all municipal water supply wells and high-capacity (greater than 70-gpm yield) water wells identified in IDNR-DOW well records within a 2-mile radius of the site
5. Locations and identification numbers for all low-volume (less than 70-gpm yield) wells within a 1-mile radius of the site
6. Areas where past spills or releases have occurred, where remediation efforts are currently being conducted, or where remediation efforts have been conducted in the past
7. Soil boring and monitoring well locations
8. Horizontal extent of contaminant migration
9. Sampling locations, including sampling depths and analytical results

10. Potentiometric surfaces for all ground water monitoring events
11. Geologic and hydrologic cross sections that define the stratigraphy, vertical extent of contaminant migration, water table, and location of free product plume, if present
12. Environmentally sensitive areas

III. Statement of Work

This section is applicable to the investigation work plan only. Those preparing investigation reports should skip to [Section V](#).

A. Investigation Objectives

1. Describe area(s) to be investigated.
2. State the objectives of the investigation for each area.
3. Explain how the site investigation will be conducted and the objectives met for
 - a. Directed investigation that focuses on known or potential sources and
 - b. Undirected, sitewide investigation (when no historical or other information is available).
4. Provide the name, address, telephone number, and qualifications of the company performing the investigation work.
 - a. Provide the name, address, telephone number, and qualifications of that company's contact person in charge of the investigation.
 - b. Provide the name, address, telephone number, and qualifications of each subcontractor (such as a drilling firm or an analytical laboratory).
 - c. Provide the certifications of drillers, geologists, engineers, and other professional staff.

B. Investigation Schedule

1. State when the investigation report will be submitted to IDEM for review and evaluation. Submittal must fall within the time constraints imposed by the appropriate program area requirements, and the submittal must be complete and include all information and data required by the appropriate program area.
2. Provide an investigation schedule that defines expected milestones, including the following:
 - a. Mobilization of field crews and equipment,

- b. Completion of all field work, and
 - c. Completion of all laboratory work.
3. Provide a projected date for submittal of the completed investigation report.

IV. Project Investigation

This section is applicable to the investigation work plan only. Those preparing investigation reports should skip to [Section V](#).

IDEM recognizes the benefits of various field techniques available to assist in defining the source area and the nature and extent of site contamination. These field techniques include blind drilling, test pit or trench excavation, electronic cone penetrating tests, and geophysical methods. Although such techniques can be used to augment or direct the placement of split-spoon soil borings and the installation of permanent ground water monitoring wells, IDEM does not recognize the results of these investigative techniques for final site confirmation. A sufficient number of soil and ground water samples must be analyzed by a laboratory to determine the full extent of contamination. Boring locations and sampling procedures should be conducted following the recommendations in Chapters 3, 4, 6 and 7 of the RISC Technical Guide.

A. Subsurface Geology Investigation

The subsurface geology investigation is conducted concurrently with the hydrogeology investigation. Subsurface geology conditions must be determined to adequately define the nature and extent of contaminant migration away from the source area and to develop a remediation plan.

1. Soil borings or push probe sample points may be placed as needed to define the vertical and horizontal extent of soil contamination. Locations must be accurately field surveyed with a horizontal closure of less than 1-foot error and accurately depicted on a scaled map of the site.
2. Physical descriptions for all soil samples must be provided and maintained in individual boring or probe logs by an Indiana licensed professional geologist. All boring or probe logs must use the same vertical scale, include a relative surface elevation, and be submitted in a complete and reproducible form. The following are also required:

- a. Continuous sampling from the top to the bottom of the hole
- b. Lithologic descriptions or USDA soil textures, degree of sorting, Munsell soil colors, locations of all sedimentary contacts, gas or vapor readings, moisture content, ground water remarks, visual indications of contamination, and other relevant information
- c. Any other pertinent information should be amended, as necessary, to describe subsurface site conditions
- d. Well driller's certification

B. Hydrogeology Investigation

As previously noted, the hydrogeology investigation is conducted concurrently with the subsurface geology investigation. Hydrogeologic conditions must be determined to adequately define the nature and extent of contaminant migration away from the source area. Because this information will be used during remediation design and development, remediation progress monitoring, and post-remediation monitoring, the ground water monitoring well network must be adequately designed during this stage of the investigation. [Section 4.4.2](#) of the RISC Technical Guide provides further recommendations regarding ground water investigations.

1. An adequate number of ground water monitoring wells, piezometers, or direct-push sampling points must be installed to adequately define the hydrology and extent of ground water contamination. Soil boring and direct-push sampling point locations can be used for well, piezometer, and ground water sampling locations. The location, sampling, and reporting requirements are the same as those outlined above for the subsurface geology investigation. The requirements below also apply.
 - a. Locations must be accurately depicted on a scaled map of the site.
 - b. Locations must be accurately field surveyed with a horizontal closure of less than 1-foot error and a vertical closure no greater than 0.01-foot error.
2. A complete boring log must be provided for each monitoring well as discussed above for the subsurface geology investigation. For nested wells, only the deepest well should be logged.

3. Ground water monitoring well installation, construction, and development procedures must follow the standards outlined in Indiana Rule, [Title 310 of the Indiana Administrative Code \(IAC\) 16-8-3\(a\) through \(m\)](#) (which is to be superseded by [312 IAC 13](#)).
4. Depending on their intended purpose, ground water monitoring wells must adhere to specific size requirements outlined in Indiana Rule [310 IAC 16-8-3\(b\)](#) (to be superseded by [312 IAC 13](#)).
 - a. Ground water wells used to monitor water quality must be at least 2 inches in diameter.
 - b. Piezometers used to monitor water levels must be at least 0.75 inch in diameter.
 - c. Sampling points resulting from the use of direct-push technologies can be used for preliminary screening purposes and for obtaining ground water grab samples to define the extent of ground water contamination. However, results from such screening and sampling are not valid substitutions for results obtained from sampling standard ground water monitoring wells.
5. The depth and interval of each well screen must be carefully planned to fulfill the intended purpose of the monitoring well and to obtain results for the chemicals of concern. When light nonaqueous-phase liquids (LNAPL) are involved, the guidelines below also apply.
 - a. For unconfined aquifer conditions, the well screen must straddle the interface between the nonsaturated and saturated zones and must be of sufficient length to account for seasonal fluctuations in ground water level.
 - b. For confined aquifer conditions, the well screen must be placed within only one water-producing horizon and must be of sufficient length to adequately monitor the entire thickness of the water-producing horizon. When dense nonaqueous-phase liquids (DNAPL) are involved, the screened intervals must be placed at the bottom of the monitored water-bearing zone(s).
6. Legible and reproducible construction logs with the same vertical scale must be submitted for each ground water monitoring well. Each construction log must include, but not necessarily be limited to, the following information:

- a. Identification and location details as outlined above for the subsurface geology investigation
 - b. Surface, top-of-casing, and bottom-of-casing elevations relative to all other elevations generated for the site
 - c. Stratigraphic horizons and depth intervals
 - d. Size and type of the monitoring well casing
 - e. Slot size of well screen
 - f. Depth and length of well screen
 - g. Type of backfill materials used in each interval
 - h. Well development description and records
- New ground water monitoring wells must not be sampled until at least 24 hours after installation and development are complete.
7. Initial and all subsequent sampling methodologies must be established and clearly stated. Sampling methods must follow the standards and guidelines established by the appropriate program area, and sampling frequency and reporting requirements must be defined.
8. Hydrologic data from initial and subsequent regularly scheduled monitoring events should include, but not necessarily be limited to, the following information:
 - a. If present, the depth to and thickness of product
 - b. Depth to water, including a corrected depth to water if free product is present
 - c. Sounding to the bottom of each monitoring well casing
 - d. Field screening parameters, such as turbidity, dissolved oxygen, oxidation-reduction potential, temperature, and pH
9. Depending on the site-specific geologic, hydrogeologic, and monitoring well conditions, standard purging, micropurging, or nonpurging methods can be used to obtain representative samples from the aquifer. Standard purging must be guided by field screening parameters, and screening results must be recorded.

Micropurging of each monitoring well must designed on an individual basis. IDEM has a web site that provides guidance on micro purging at:
www.state.in.us/idem/olq/publications/papers/index.html

Micropurging can be used if the chemicals of concern are metals, DNAPLs, or hydrocarbons. The requirements below also apply to micropurging.

 - a. An in-well pump must be used.

- b. Purging must be conducted at a very low pumping rates of 0.1 to 1.0 liter per minute (L/min).
 - c. Purging must continue until field screening parameters exhibit steady-state conditions.
 - d. Screening results must be recorded.
- Nonpurge sampling can be used if chemicals of concern are limited to hydrocarbons; benzene, toluene, ethylbenzene, and xylene (BTEX); and methyl tertiary butyl ether (MTBE). Nonpurge sampling cannot be used when the chemicals of concern are metals, DNAPL, or other pollutants. The requirements below also apply to nonpurge sampling.
- a. Ground water is present in an unconfined aquifer.
 - b. Free product or a visible sheen is not present.
 - c. Dedicated sampling equipment is not stored within the well.
 - d. The water level at the time of sampling is not above the top of the screened interval.
 - e. Final confirmation sampling for site closure includes results from both purge and nonpurge methods for each well.
10. One ground water sample from each monitoring well must be collected and maintained for shipment to a qualified laboratory for analyses. The investigation report should provide the following information:
- a. Type of purging, sampling, sampling equipment, sample containers, and preservation techniques
 - b. Analytical methods, which must be appropriate for the chemicals involved
 - c. Sampling documentation and chain-of-custody record requirements, which should be maintained and submitted for IDEM review and evaluation
11. The sampling methodology and procedures must be detailed in the sampling section of each corrective action plan and progress report.

A. Ecological Evaluation of Susceptible Areas

[Chapter 5](#) of the RISC Technical Guide discusses ecological evaluation of susceptible areas. The investigation report should include, as appropriate, the following information:

1. Potentially affected endangered species
2. Environmentally sensitive areas or habitats of concern, such as surface waters, riparian areas, wetlands, and flood plains
3. Aquatic and riparian species present near the site, including potential exposure of aquatic and riparian species to site-related chemicals of concern and observed impacts to surface water quality and aquatic and riparian species
4. Area wildlife and vegetation
5. Potential wildlife and vegetation exposure pathways, including observed impacts on wildlife or vegetation

D. Background Concentration Assessment

Background concentrations are useful as a basis for determining the nature and extent of soil and ground water contamination. In some site- and program-specific cases, background concentrations are used to determine final cleanup levels. Section 3.3.4.1 of the RISC Technical Guide recommends procedures for background sampling. Background sampling procedures must be conducted in accordance with the quality assurance project plan (QAPP). [Chapter 3](#) of the RISC Technical Guide discusses QAPP requirements. The investigation report should include the following information with regard to background sampling:

1. Background investigation analytical methods
2. Methods used to collect background data (for example, sampling of soil borings or monitoring wells or reviews of existing data or literature)
3. Background sampling locations map
4. Background data in tabular form, including media, parameters, concentrations, and sampling depths and dates
5. Statistical evaluation of background results

V. Investigation Results

This section is applicable to the investigation report only. Those preparing investigation work plans should skip to Section VII.

The site investigation report should include the results of the subsurface geology and hydrogeology investigations and of laboratory analyses performed on collected samples. The results must be consistent with guidelines of the appropriate program area and be accurate and complete because the results will be used to interpret site

geology, hydrogeology, and the nature and extent of contaminant migration. Ultimately, the results will be used to develop conclusions and remediation recommendations. Tables, figures, and maps should be used whenever possible to summarize data and clearly present information or recommendations.

A. Subsurface Geology and Hydrogeology Investigation Results

1. Provide an interpretation of sitewide stratigraphy based on soil encountered during drilling operations and described in boring logs, including the following:
 - a. Cross sections of the soil horizon correlated to soil and monitoring well borings
 - b. Physical characteristics of soils that could result in preferred contaminant migration pathways
 - c. Horizontal and vertical extent of soil contamination
2. Provide an interpretation of sitewide hydrogeology based on conditions encountered during drilling operations and groundwater monitoring events, including the following:
 - a. Vadose zone depth, thickness, and seasonal fluctuations in depth and thickness
 - b. Horizontal and vertical extent of soil contamination in the vadose zone
 - c. Type(s), depth(s) to, and thickness(es) of aquifer(s) present
 - d. Physical description of aquifer(s) present, including the following:
 - Hydraulic conductivity
 - Porosity
 - Storativity
 - Specific yield
 - Aquifer test results
 - e. Ground water level measurements, including the following:
 - Ground water flow direction
 - Ground water flow gradient and velocity
 - Seasonal fluctuations in water levels and their effect on flow direction
 - Water table elevations and potentiometric surface
 - f. Ground water quality in all encountered aquifers, significant zones of saturation, and permeable zones, including the following:
 - Areal extent of free product plume(s)

- Horizontal and vertical extent of dissolved ground water contamination
- Velocity of contaminant movement in ground water

B. Laboratory Analytical Results

1. Include laboratory analytical reports in Appendix D.
2. Identify parameters detected above the action levels for the chemicals of concern.
3. Identify parameters detected below the action levels for the chemicals of concern.
4. Describe contamination in other affected media, such as sediment, surface water, and other media.

VI. Conclusions and Recommendations

This section is applicable to the investigation report only. Those preparing investigation work plans should skip to Section VII.

The investigation report must provide an overall assessment of the nature and extent of on- and off-site contamination, an initial assessment of potential risks associated with the contamination, and an assessment of any additional work required. If remediation is planned, the report should provide preliminary remediation alternatives to the extent possible. A tentative schedule for the submission of a remediation work plan must also be provided.

A. Summary of Results

1. Type(s) of chemical(s) encountered and concentrations exceeding appropriate action levels, including the following:
 - a. Tabulated field screening results
 - b. Table(s) of analytical methods, sample containers, and preservation procedures for each sample matrix and sampling location (see [Section VIII.A](#))
 - c. Table(s) presenting analytical results for all media where parameters exceeded method detection levels (see [Section VIII.A](#))
2. Type(s) of media impacted
3. Horizontal and vertical extent of contaminant migration, including the following:
 - a. Tabulated water level measurements
 - b. Geologic and hydrogeologic cross sections

- c. Site soil stratigraphy identification
- 4. Data gaps

B. Summary of Potential Risks Associated with Site

- 1. Both long- and short-term human, ecological, and environmental risks
- 2. Possible human, ecological, and environmental receptors
- 3. Current and future land-use issues, if applicable

C. Preliminary Remediation Alternatives

Feasibility studies must be taken into account when recommending remediation alternatives. The following requirements also apply to the discussion of each alternative:

- 1. Evaluation of overall effectiveness
- 2. Ability to achieve cleanup criteria
- 3. Expected treatment duration
- 4. Demonstrated treatment reliability
- 5. Permits required
- 6. Cost and time requirements

D. Recommended Remediation Method

- 1. Chosen remediation method
- 2. Schedule for submitting complete remediation work plan

VII. References

References used to prepare the investigation report or work plan or cited should be listed. Information should include author, full title, publisher, company, date, and other relevant publication information.

VIII. Appendices

A. Tables (as applicable)

- 1. Field screening results
- 2. Analytical methods, sample containers, and preservation methods
- 3. Analytical results from all media for parameters exceeding the method detection limit
- 4. Tabulated water level measurements

B. Maps and Figures

[Section II.L](#) presents detailed guidance on preparing maps and figures.

C. Site-Specific QAPP

A QAPP is required for the investigation report only. QAPPs need not be prepared for investigation work plans. The QAPP should contain all elements discussed in [Chapters 3 and 4](#) of the RISC Technical Guide.

D. Laboratory Analytical Results

Guidelines for submitting laboratory analytical results for the investigation report are presented in [Section V.B](#).

A1.2 Remediation Work Plan

IDEM will evaluate the proposed remedy for each site. Information required to evaluate a selected remedy's effectiveness must be provided in the remediation work plan to demonstrate that it is the most effective remedy for the site. The remediation work plan must provide a complete description of the selected remedy, including the following:

- Discussion of the proposed extent of remediation
- Anticipated volume of contaminated material
- Proposed treatment systems
- Transportation distances for removed contaminated media
- Selection of remedial alternatives
- Treatability study reports
- Design and equipment specifications
- Permit application and disposal approvals
- Monitoring and confirmation sampling results
- Progress reports
- Equipment certification
- Operation and maintenance (O&M) plan
- Community relations activities
- Schedule of the remedial activities planned
- Other pertinent information

Specific requirements are discussed below.

Remediation Work Plan Overview

- ✧ Introduction
- ✧ Investigation Activities
- ✧ Remediation Plan
- ✧ References
- ✧ Appendices

I. Introduction

Information provided in the introduction can simply summarize pertinent information provided in the investigation report. Additional information collected after the last investigation report was prepared must also be included in this section.

A. Project Background

1. Site name, address, and telephone number
2. Current owner identification and address information
3. Historical summary of site ownership
4. Type of facility, including description of past and current operations
5. Site contact person or group responsible for guiding the investigation project
6. Overview of initial discovery of contamination, spill history, and previous investigations conducted at the site

B. Supporting Documentation

1. Discussion of relevant previous reports
2. Description of available data and other applicable documentation regarding the site or project

C. Remedial Action Objectives

1. Remediation and cleanup objectives for all affected media, contaminants, and exposure pathways
2. Work items planned for the remediation

II. Investigation Activities

A. Summary of Information Used to Select Remedy

The remediation work plan should summarize all information used to develop conclusions and recommendations regarding the most appropriate remedy. This information should be a synopsis of results, conclusions, and recommendations from previously prepared documents.

1. Results of baseline assessment and literature search, including the following:
 - a. Geologic and hydrologic information summary

- b. Physical and political geographic information summary
 - c. Identification of susceptible areas (see [Chapter 5](#) of the RISC Technical Guide)
- 2. Extent of the subsurface work performed during site investigation, including the following:
 - a. Copies of boring logs and monitoring well construction logs
 - b. Copies of maps showing boring and monitoring well locations
 - c. Field screening results for all soil samples collected
 - d. Sampling locations for soil samples submitted for laboratory analysis

B. Summary of Site Investigation

- 1. Identification of all contaminants, including the following:
 - a. Chemical and physical properties
 - b. Contaminant toxicological data
 - c. All potential effects of residual contamination
- 2. Summary of site-specific geology and hydrogeology
- 3. Discussion of identified sources of contamination
- 4. Summary and map of full horizontal and vertical extent of contamination, including the following:
 - a. Impacted environmental media, such as soil, sediment, ground water, surface water, and air
 - b. Concentrations of contaminants detected in environmental media
 - c. Concentration trends if historical data are available

C. Summary of Risks Associated with Site

- 1. Human, ecological, and environmental risks for each contaminant and impacted media, including discussion of long- and short-term risks, environmentally sensitive areas, and endangered species
- 2. Impact of current and future land-use issues, if applicable, including need for environmental notice and deed restrictions

D. Summary of Background Concentration Assessment

Section 3.3.4.1 of the RISC Technical Guide recommends procedures for background concentration assessment. The summary can include field and laboratory results as well as statistical methods. In addition, the following information is required:

1. Summary of site-specific waste constituents or chemicals that occur naturally in the soil for each soil horizon or appropriate interval
2. Background data in tabular format and background sampling location map
3. Statistical comparison of background concentrations to concentrations in potentially contaminated media
4. Conclusions on the reliability of the background concentration information and its applicability in determining final cleanup values

E. Additional Field Investigation Requirements

1. Additional investigations required to effectively complete the design or the installation of the selected remedial method
2. Reasons for additional investigation
3. Complete description of additional investigation to be completed

III. Remediation Plan

Screening of potentially applicable technologies must include the evaluation of each technology's technical feasibility, protectiveness of human health and the environment, cost, need for treatability testing, ability to achieve proposed closure criteria, and community acceptance. The evaluation of alternatives must include cost estimates for completing the remediation. Estimates must include installation, startup, O&M, performance monitoring, and all sampling and analysis costs. IDEM will use this information to estimate review and oversight costs and to evaluate remediation progress.

A. Evaluation of Remedial Alternatives

1. The remedial alternatives evaluated must be identified, and the rationale for their selection must be provided. In addition, the remediation work plan should describe parameters evaluated for each of the selected alternatives. The parameters should include, but not necessarily be limited to, the following:

- a. Extent of remediation effort
 - b. Technical feasibility to address physical and chemical characteristics of media
 - c. Projected contaminant removal and treatment rates
 - d. Protectiveness of human health
 - e. Cleanup criteria
 - f. Ability of each alternative to achieve cleanup criteria
 - g. Community acceptance
 - h. Anticipated volume of contaminated materials to be treated
 - i. Ease of technology application or implementation
 - j. Dimensions of major technologies and space limitations
 - k. Process parameters
 - l. Cleanup time frames
 - m. Transportation distances
 - n. O&M costs
 - o. Any other special considerations
2. Summarize conclusions for each of the technologies evaluated, and provide reasons each technology would or would not be appropriate.
3. Identify the need for a treatability study or pilot test. Describe the treatability study or pilot test and the reasons it is required, and provide the following information:
 - a. Proposed study methodology
 - b. Clear statement of treatability study or waste characterization objectives
 - c. Proposed scale of the study (such as bench-scale or pilot-scale)
 - d. Data requirements and proposed data evaluation
 - e. Pilot plant startup and O&M
 - f. Anticipated date study report will be submitted
 - g. Remedial technologies to be tested and equipment required
 - h. Treatability study and waste characterization, as applicable
 - i. Proposed disposal arrangements for wastes generated during remediation, including approvals or other necessary documentation
 - j. Installation and startup procedures, including the following:

- Data requirements and analytical methods to be used
 - Pilot plant O&M requirements
 - Data analysis and interpretation of results to be used
 - Full-scale technology application requirements and identification of limitations and optimum operating conditions
- k. Statement of intention to submit report detailing treatability study or pilot test results
 - l. Description of review and evaluation of the treatability study or pilot test results
 - m. Estimated startup time of remediation system if results indicate that the chosen technology will work as designed
 - n. Alternative plans if results indicate that the chosen technology will not work as designed

B. Selected Remediation Technology

If more than one remedial alternative will be used to address different on-site areas, the remediation work plan must describe how the remediation system as a whole will work. A flow diagram, conceptual sketch, or other approach should be used to illustrate the components of the remediation system. Major equipment, such as pumps, air strippers, and in situ treatment equipment, must be indicated. The work plan should include a site map showing areas to be remediated and proposed locations of major equipment.

1. Identify which evaluated technology or combination of technologies will be implemented at the site, including the technical, economic, and social acceptance rationales for the final selection.
2. Identify the need for a risk assessment, and provide the following information:
 - a. Parameters to be addressed by the risk assessment
 - b. Proposed risk assessment methodologies
 - c. Potential exposure pathways
 - d. Exposure assumptions
 - e. Environmental fate and transport data development procedures
 - f. Table that lists the parameters and calculated cleanup levels

3. Provide a detailed description of the selected technology and system setup, including the following information:
 - a. Technical specifications of all equipment and processes
 - b. Proposed locations of all remediation equipment on a scaled site map, including piping runs and electrical wiring where applicable
 - c. State or federal permit requirements for the system
 - d. Waste disposal approvals needed to implement the system

C. Monitoring and Sampling Plan

A sampling plan must be developed to track remediation progress and eventually confirm that closure levels have been achieved. Well organized and well presented data contribute significantly to the efficient review and oversight of remediation projects. Tabular formats are preferred wherever possible. The frequency, content, and format of progress reports to be submitted to IDEM during implementation of the remediation work plan should also be discussed.

1. Provide sampling plan details (follow previously approved sampling guidelines) for the following information:
 - a. Sampling and monitoring parameters
 - b. Sampling and monitoring frequency
 - c. Schedule for submitting results to IDEM for review and evaluation (quarterly progress reporting is minimum requirement)
2. Provide data management details, including a discussion of how the monitoring and confirmation sampling data will be documented and reported, and the proposed format for progress reports.

D. Projected Work Schedule

It is critical that the remediation work plan include a detailed schedule for implementation. The schedule will enable IDEM to coordinate implementation oversight activities and the final site inspection with the applicant. The proposed schedule should allow sufficient time for review, public notice, and approval by IDEM before work begins. The schedule should identify the following:

1. Projected installation and startup schedule
2. Sampling and monitoring schedule
3. Contaminant removal and treatment rates, including remediation progress milestones and projected completion dates
4. O&M plan, including the following information:
 - a. Optimum operating conditions
 - b. Necessary O&M tasks, their frequency, replacement schedule, and planned O&M replacement events
 - c. Proposed inspection tasks and schedule
 - d. Potential problems and their remedies
 - e. Contingency plan indicating how the applicant plans to respond in the event of a system failure, including the following information:
 - Description of alternate operation procedures to prevent undue hazards if the system fails
 - Notification procedures in case of system shutdown or failure
 - System modification procedures

IV. References

References used to prepare the remediation work plan or cited in the plan should be listed. Information should include author, full title, publisher, company, date, and other relevant publication information.

V. Appendices

A QAPP is required for the remediation work plan. The QAPP should contain all elements discussed in Chapters 3 and 4 of the RISC Technical Guide. If a QAPP was already submitted as part of the investigation report, it need not be resubmitted.

A1.3 Remediation Progress Report

Remediation Progress Report Overview

- ◇ Introduction
- ◇ Regularly Scheduled Monitoring and Sampling Events

At a minimum, remediation progress reports summarizing sampling and monitoring results must be submitted on a quarterly basis. Results must be recorded on the Corrective Action Progress Report form, which is presented in [Appendix 3.4](#) of this User's Guide. At the end of the project, a final report must be filed to document that closure goals and objectives have been achieved.

I. Introduction

A. Project Identification

1. Site name, facility identification number(s), mailing address, and telephone number
2. Site location clearly marked on appropriate U.S. Geological Survey 1:24,000 scale topographic quadrangle map
3. Current owner and operator, mailing address, and telephone number
4. Site contact person or group responsible for the investigation
5. Sampling and monitoring dates

B. Brief Narrative of Remediation Process

1. Basic description of process(es) involved
2. Information about when the remediation system was started

II. Regularly Scheduled Monitoring and Sampling Events

- A. Data from current and previous monitoring and sampling events
- B. Graphical display of data to show remediation effectiveness and trends, including historical comparison with previous sampling results
- C. Summary of O&M or downtime experienced during current reporting period, including the following:
 1. Reasons for O&M problems or downtime
 2. Length of downtime
 3. Corrective measures taken to repair the system
- D. Recommendations concerning need for additional monitoring and sampling events, including the following:
 1. Continued monitoring and sampling if cleanup criteria have not been achieved
 2. Final confirmation monitoring and sampling if cleanup criteria have been achieved, including a confirmation sampling plan for all impacted media, confirmation sampling locations, and confirmation sampling schedule

Closure Report
Overview

- ✧ Introduction
- ✧ Confirmation Sampling

A1.4 Closure Report

The primary purpose of the closure report is to document completion of activities identified in the remediation work plan (see [Appendix A1.2](#)). The report also provides information about the performance of the remediation system and indicates how the site was or will be restored following remediation.

I. Introduction

A. Project Identification and Site Background

1. Site name, facility identification number(s), address, and telephone number
2. Current owner and operator, mailing address, and telephone number
3. Site contact person or group responsible for guiding the remediation project(s)
4. Historical summary of site ownership
5. Type of facility, including description of past and current operations
6. Site location map and site layout drawing showing the following:
 - a. Property boundaries, roads, loading and unloading areas, and building outlines
 - b. Locations of treatment or disposal areas, remediated areas, ground water monitoring wells, ground water production wells, sampling points, and major remediation equipment
 - c. Raw materials and bulk storage areas
7. Overview of the initial discovery of contamination, spill history, investigations conducted at the site, and remediation history
8. List of previously completed reports concerning the site, and a discussion of other data and documentation available for the site

B. Remediation Effort

1. Description of the remediation system, including a block flow diagram or other conceptual illustration of the system as installed and major equipment used or installed
2. Evaluation of overall system performance, including discussion of procedures used to measure and document

- system performance, significant problems that occurred, and how the problems were addressed
3. Description of remedial action(s) undertaken at the site, including the following:
 - a. Summary of remedial activities performed
 - b. Description of wastes generated during remedial activities, including total volumes or amounts and final disposition
 - c. Description of time required to achieve full remediation

II. Confirmation Sampling

IDEM must receive advance notice before any confirmation sampling is conducted so that the sampling activities can be observed and duplicate samples can be collected, if appropriate. IDEM will not evaluate any requests for No Further Action, final closure, Covenant Not to Sue, or other actions until the final report has been approved and confirmation monitoring and sampling have been completed.

The closure report must describe confirmation sampling procedures as they were actually implemented. The actual numbers and locations of confirmation samples must be shown on a map. Analytical results must be presented in tabular form, addressing all sampling locations, affected media, and contaminants. The name, address, and telephone number of the laboratory or (laboratories) that performed the analyses must also be identified. Copies of laboratory reports and chain-of-custody forms should be provided in Appendices A and B.

- A. The confirmation monitoring portion of the closure report must include the information below.
 1. Data from most recent monitoring and sampling event
 2. Graphical display of data to show remediation effectiveness and trends, including historical comparison with previous sampling results
 3. Summary of O&M problems or downtime experienced during current reporting period, including the following:
 - a. Reasons for O&M problems or downtime
 - b. Length of downtime
 - c. Corrective measures taken to repair the system
 4. Recommendations concerning need for additional monitoring and sampling events, including the following:

- a. Continued monitoring and sampling if cleanup criteria have not been achieved, including re-evaluation of time required to achieve cleanup criteria and revised monitoring and sampling schedule
- b. Final closure report submittal if cleanup criteria have been achieved, including the following:
 - Final confirmation monitoring and sampling report
 - Information that demonstrates that cleanup criteria have been achieved
 - Clear statement of expected future uses of the site after remediation is completed (such as residential or nonresidential)
 - Discussion of deed restrictions, land-use restrictions, or environmental notice requirements

B. Completed Field Work and Laboratory Analysis

- 1. Summary of confirmation sampling performed, including the following:
 - a. Confirmation sampling procedures
 - b. Confirmation sampling locations on a plan view map
 - c. Rationales for sampling locations and number of samples collected
- 2. Confirmation sampling results, including the following:
 - a. Tabulated or graphical representation of results for all affected media and contaminants, including historical comparison of contaminant concentrations
 - b. Laboratory reports in Appendix A, including the following:
 - List of analytical methods used and associated parameters
 - Name, address, and telephone number of laboratory
 - c. All chain-of-custody forms in Appendix B

C. Evaluation of Confirmation Sampling Results

- 1. Comparison of confirmation sampling results with the agreed upon cleanup levels
- 2. Acceptable cleanup criteria for all contaminants of concern and for all affected media

3. Demonstration that acceptable cleanup criteria have been met

D. Final Site Restoration

A description of work required to restore the site after remediation is required. Issues such as monitoring well abandonment and equipment dismantling must be addressed.

1. Summary of site restoration work, including the following:
 - a. Description of how disturbed areas have been or will be restored
 - b. Completion schedule for restoration activities
2. Description of remediation equipment dismantling and removal, including the following:
 - a. Description of decontamination procedures
 - b. Description of decontamination verification sampling
 - c. Description of waste disposal activities conducted

III. Appendices

- A. Copies of Laboratory Reports
- B. Chain-of-Custody Forms